What is claimed is:

1. A solid state laser module for amplification of laser radiation, comprising:

a laser gain medium having a pair of generally parallel surfaces and forming a disc-like shape;

said pair of surfaces being adapted for at least one of receiving and transmitting laser radiation;

at least one undoped optical medium disposed adjacent a peripheral edge of said laser gain medium and in optical communication with said laser gain medium;

a source of optical pump radiation for directing optical pump radiation into said undoped optical medium generally normal to said generally parallel surfaces; and

said undoped optical medium operating to transport said optical pump radiation into said laser gain medium and to pump said laser gain medium to a laser transition level.

2. The laser module of claim 1, wherein said undoped optical medium is attached to said peripheral edge of said laser gain medium.

3. The laser module of claim 1, wherein said undoped optical medium is in thermal communication with said laser gain medium.

4. A solid-state laser module for amplification of laser radiation comprising:

a laser gain medium having a pair of surfaces having a first dimension, said pair of surfaces further being opposed to each other and being separated by a peripheral edge surface of said laser gain medium, said laser gain medium having a thickness representing a second dimension which is substantially smaller than said first dimension;,

said pair of surfaces thereof being adapted for receiving and transmitting said laser radiation;

at least one undoped optical medium attached to said peripheral edge and in mechanical, thermal, and optical communication therewith;

a source of optical pump radiation; said source directing optical pump radiation into said undoped optical medium; and

said undoped optical medium transporting said optical pump radiation into said laser gain medium and pumping said laser gain medium to a laser transition level.

5. The laser module of claim 4, wherein said pair of surfaces of said laser gain medium are generally at a Brewster angle with respect to an axis of propagation of said laser radiation.

6. The laser module of claim 4, wherein said pair of surfaces of said laser gain medium are generally normal with respect to an axis of propagation of said laser radiation, and further have optical coatings for providing reduced reflectivity at a lasing wavelength of said laser gain medium.

7. The laser module of claim 4, wherein at least one of said pair of surfaces is cooled by a cooling medium flowing in a direction generally parallel to said surfaces.

8. The laser module of claim 7, wherein the cooling medium comprises a gaseous form.

9. The laser module of claim 4, wherein said peripheral edge of said laser gain medium has a shape selected from the group of shapes consisting of circular, elliptical, rectangular, pentagonal, hexagonal, heptagonal, octagonal, and polygonal.

10. The laser module of claim 4, wherein said peripheral edge of said laser gain medium comprises a plurality of planar sections; and

wherein said laser gain medium includes a corresponding plurality of undoped optical medium sections that are secured to said planar sections via a bond which is transparent at wavelengths of said optical pump radiation and at a lasing wavelength of said laser gain medium.

11. The laser module of claim 4, wherein said undoped optical medium is secured to said peripheral edge via a bond which is transparent at wavelengths of said optical pump radiation and at a lasing wavelength of said laser gain medium.

12 . The laser module of claim 14, wherein said optically transparent bond is produced by one of the group consisting of: fusion bonding, diffusion bonding, optical contacting followed by heat treatment, and adhesive bonding.

13. The laser module of claim 4, wherein laser gain medium comprises a host lattice, and wherein said host lattice and said undoped optical medium are selected from the group consisting of:

yttrium aluminum garnet YAG), gadolinium gallium garnet (GGG), gadolinium scandium gallium garnet (GSGG), yttrium lithium fluoride (YLF), yttrium vanadate, potassium gadolinium tungstate ($KGd(WO_4)_2$), potassium yttrium tungstate ($KY(WO_4)_2$), phosphate glass, athermal glass, silicate glass, and sapphire.

14. The laser module of claim 13, wherein said host lattice is doped with a material selected from the group consisting of: Ti, Cu, Co, Ni, Cr, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, and Yb.

15. The laser module of claim 4, wherein said laser gain medium comprises trivalent Yb ion.

16. The laser module of claim 15, wherein said trivalent yb ion is doped into host material selected from the group consisting of: YAG, GGG, phosphate glass, athermal glass; and

wherein said source of optical pump radiation comprises an InGaAs diode laser array.

17. The laser module of claim 15 wherein the optical pump radiation is provided at the wavelength generally corresponding to a zero-phonon spectral line of the trivalent Yb ion.

18. The laser module of claim 4, wherein said laser gain medium comprises trivalent Nd ion.

19. The laser module of claim 18, wherein said trivalent Nd ion is doped into host material selected from the group consisting of: YAG, GGG, phosphate glass, athermal glass.

20. The laser module of claim 4, wherein said source of optical pump radiation comprises a diode laser array.

21. The laser module of claim 18, wherein the optical pump radiation is provided at the wavelength of an absorption feature of the trivalent Nd ion at about 880 nanometers corresponding to direct energy deposition into an upper laser level.

22. The laser module of claim 4, wherein the optical pump source is comprised of at least one diode laser array.

23. The laser module of claim 4, wherein said optical pump source comprises a plurality of microlenses.

24. The laser module of claim 4, further comprising a plurality of said optical pump sources, and wherein said optical pump sources are arranged in a pattern generally larger and of the same shape as the perimeter of said laser gain medium and with individual optical pump sources generally pointed towards said laser gain medium.

25. The laser module of claim 4, further comprising at least one tapered duct for concentration of said optical pump radiation, said tapered duct being interposed between said undoped optical medium and a source of optical radiation for directing optical pump radiation toward said undoped optical medium.

26. The laser module of claim 25, wherein said tapered duct is comprised of solid optical material.

27. The laser module of claim 25, wherein said tapered duct comprises a hollow duct.

28. The laser module of claim 25, wherein said hollow duct is filled with a liquid highly transparent at the wavelength of said optical pump radiation.

29. The laser module of claim 4, wherein said undoped optical medium includes at least one tapered portion for concentration of said optical pump radiation.

30. The laser module of claim 4, wherein said undoped optical medium includes at least one curved surface to provide a lensing effect for concentration of said optical pump radiation.

31. The laser module of claim 4, wherein said laser gain medium is suspended by said undoped optical medium.

32. The laser module of claim 4, wherein said laser gain medium is operated in a heat capacity mode so as to be turned on and off intermittently depending on a temperature of said laser gain medium.

33. The laser module of claim 4, wherein said laser gain medium is continuously cooled.

34. The laser module of claim 4, wherein said laser gain medium is cooled by a cooling medium flowing over said pair of first surfaces.

35. The laser module of claim 34, wherein said cooling medium comprises a gaseous form.

36. A solid-state laser module comprising:

a laser gain medium having a pair of surfaces opposite to each other having a first dimension, a peripheral edge surface therebetween, and a thickness forming a second dimension; and

a plurality of sources of optical pump radiation, said sources being arranged around said peripheral edge and directing optical pump radiation thereinto, said arrangement of said sources being chosen to produce generally uniform laser gain within a volume of said laser gain medium.

37. The laser module of claim 36, further comprising at least one lensing element disposed between one of said sources of optical pump radiation and said peripheral edge, said lensing element concentrating said optical pump radiation into said peripheral edge.

38. The laser module of claim 36, further comprising at least one tapered optical duct disposed between at least one of said sources of optical pump radiation and said peripheral edge, said tapered optical duct concentrating said optical pump radiation into said peripheral edge.

39. The laser module of claim 36, further comprising at least one undoped optical medium affixed to said peripheral edge via an optically transparent bond, said undoped optical medium conveying said optical pump radiation into said peripheral edge.

40. The laser module of claim 36, wherein said optically transparent bond is produced by an optical contacting method.

41. The laser module of claim 36, wherein said tapered optical duct comprises a hollow tapered duct.

42. The laser module of claim 36, wherein said tapered optical duct comprises a solid tapered duct made of an optical medium generally transparent to said optical pump radiation.

43. The laser module of claim 36, wherein said tapered optical duct comprises a liquid-filled tapered duct; said liquid being highly transparent to said optical pump radiation.

44. A laser amplifying system comprising:

a rigid substrate having a plurality of internal passages forming channels opening onto one of its surfaces;

a laser gain medium having first and second surfaces each having a first dimension and being separated by a peripheral edge surface, said peripheral edge surface having a thickness representing a second dimension substantially smaller than said first dimension;

each of said pair of surfaces including an anti-reflection coating being substantially totally transmissive of radiation at a wavelength at which laser gain is produced therein;

an undoped optical medium affixed to said peripheral edge surface of said laser gain medium;

a system for providing pump radiation to said undoped optical medium;

a system for providing laser radiation to said laser gain medium for amplification therein; and

a system for flowing cooling fluid over at least one of said pair of surfaces.

45. The laser amplifying system as defined in claim 44, wherein a cooling fluid is flowed through said internal passages inside said rigid substrate, and said cooling fluid directly wets said surface of said laser gain medium in contact with rigid substrate to remove heat from said medium.

46. The laser amplifying system as defined in claim 44, wherein heat generated in said laser gain medium is conducted across said second surface into said rigid substrate, said rigid substrate including a plurality of cooling channels not connected to said internal passages, and wherein a cooling fluid is flowed through said cooling channels inside said rigid substrate and removes heat therefrom.

47. The laser amplifying system as defined in claim 44, wherein said first and second surfaces of said laser gain medium are planar and generally parallel when subjected to a difference in pressure between said passages of said rigid substrate and an exterior of said first surface of said laser gain medium, and said surface of said rigid substrate facing said laser gain medium being planar.